INSECTS ASSOCIATED WITH SEQUOIA SEMPERVIRENS AND SEQUOIA GIGANTEA IN CALIFORNIA[1]

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INTRODUCTION

Many people believe that the coast redwood *Sequoia sempervirens* (Lamb.) Endl. and the giant sequoia *Sequoia gigantea* (Lindl.) Decne are either remarkably resistant to insect feeding or are not fed upon at all. Such, however, does not seem to be the case. A good many insects breed in or on both species of *Sequoia.* There are insects that feed on the foliage, in the thick bark, in the phloem, and in the solid wood. It is true that, when compared with some of the other conifers, the number of species of insects attacking the sequoias is rather small. Just why this is so is not known. It may be that, since the sequoia is a tree left over from past geological ages, most of the insects for which it was originally a host have died out. It is more probable that, like the California nutmeg *Taxus brevifolia* Nuttall, the western yew *Tumion californicum* (Torrey) Green, and other species of plants, not many insects that feed on sequoias have developed.

Some people believe that the sequoias' supposed repellent or resistant properties are due to chemicals in the wood. Sherrard and Kurth (1933) have shown that there are extractives in the heartwood which prevent growth of certain fungi, but, so far as the writer is aware, no worker has shown that there is a chemical in the living portions of the tree—i.e., the sapwood, cambium, or leaves—which is repellent to insects.

The statement is often made that the sequoias' thick bark pro-

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[1]The names preceded by an asterisk (*) are new host records. Original notes for several species, kindly furnished by E. G. Linsley, E C. Van Dyke, and Emanuel Fritz, of the University of California, and H. L. McKenzie, of the California State Bureau of Entomology and Plant Quarantine, are acknowledged under the insects concerned. The biological notes for the other species are from the files of the Forest Insect Laboratory, U. S. Bureau of Entomology and Plant Quarantine, Berkeley, California, and from the writer's notes, made when he was earlier employed by the National Park Service. Other assignments have prevented the completion of this paper, which was interrupted by the writer's entrance into the Army in 1942. Although the literature has not been searched since that date and the references consulted before that date have not been tied into the text, it seems advisable to make this information available to other workers as it is. F. P. Keen, in charge of the Forest Insect Laboratory at Berkeley, attended to the final details of this paper.

tects them from insect attacks, but some insects easily bore through the bark, and one species apparently is able to develop in the bark alone. Moreover, the bark on the upper portion of the bole and on the branches is thin, seldom being over 1/3 inch thick, and the bark on the lower portions of the bole is so deeply grooved on large trees that in many places the distance from the surface to living tissue is less than 1 inch. As soon as a tree is cut or a limb is broken, it is promptly and heavily attacked through the bark by insects which earlier made no attempt to attack it. Such evidence seems to indicate that a living tree is not attractive to these insects.

The supposed resistance of living trees to insect attack is commonly given as one of the chief reasons for the great age which sequoias attain. However, the western yew and the California nutmeg have fewer insects attacking them, and these two species are not known to live longer than 400 years. The real reason for the great age of the sequoias seems to be that the development of senescent cells in an individual tree is a matter of several hundred years, rather than of decades or shorter periods, as is the case for much plant life. Trees, like other organisms, have life spans that vary in different kinds. Some, such as digger pine and dogwood, are short-lived; others, such as the oaks and sequoias, are long-lived. Some kinds are more heavily beset by insects than other kinds; but, although insects may kill off more individuals of the former than of the latter, the life span of the species is not affected.

Except for several species of scales, all the insects discussed below are native. No other introduced insects are known to attack either species of sequoia. No attempt has been made to list the insects attacking either coast redwoods or giant sequoias that have been introduced into other parts of the world.

COAST REDWOOD INSECTS

Bark Beetles

The redwood bark beetle *Phloeosinus sequoiae* Hopkins is the most common insect attacking redwood throughout its range. The adult is about 4 mm. long, barrel-shaped, and very dark brown to nearly black. The wing covers of some individuals often remain a reddish brown. The larvae are curved, legless, and whitish, with light brown heads.

The beetles are attracted to weakened and recently felled trees and to injured or broken branches. The attacking beetle, which is

always the female, bores through the bark to the wood and there excavates a tunnel up the tree along the grain of the wood. Eggs are laid on each side of the gallery, and the larvae hatching from them mine out at right angles to the egg gallery. Pupation occurs either in the wood or in the bark. There is apparently little preference in regard to the size of the tree attacked. Trees 6 feet in diameter are infested as readily as limbs less than ½ inch in diameter. In the thick-barked portions the egg galleries are entirely in the bark; in small branches the egg galleries are entirely in the wood.

Winter is passed in the larval, new adult, and parent adult stages. Attacks are made through the warmer months of the year, but the main flight period appears to occur in May. There is considerable variation in the number of attacks per square foot. In one tree 22 inches in diameter the attacks averaged 17 per square foot, but they are usually fewer than this.

As mentioned above, the female beetle initiates the attack and only one pair of beetles is found in each gallery. The egg galleries average about 2⅝ inches in length. The shortest observed was 1 inch, the longest, 6 inches. Counts made in 11 galleries showed an average of 48 eggs per female. The maximum number observed was 171; the minimum, 36. The incubation period is not definitely known. The larvae require at least 2 months to complete development. There is considerable overlapping of broods, but observations indicate that there are two generations a year.

Thanasimus repandus Horn is a common predator of this beetle. A larva collected in October pupated by November 18 and transformed to an adult between December 1 and 17 of the same year. The adult is about 8 mm. long. The head, legs, and posterior half of the wing covers are black; the pronotum, base of the wing covers, and abdomen are red; a narrow band of white hairs separates the red from the black on the wing covers, and there is a wider band of white hairs across the wing covers near each tip. The predator seems to be restricted to this host, where it also feeds on *Dicentrus bluethneri* LeConte.

Lasconotus vegrandis Horn is fairly common in the egg galleries of the redwood bark beetle. The larvae probably prey on the eggs and young bark-beetle larvae. It is a slightly flattened reddish-brown beetle about 3 mm. long. Each wing cover bears six distinct ridges with a double row of coarse punctures between the ridges except

the outermost one. All the ridges are crested with silvery recumbent hairs.

The following parasites have been reared from limbs infested with the redwood bark beetle:

Heydenia unica Cook and Davis
Eurytoma phloeotribi Ashmead
Spathius sequoiae Ashmead
Ecphylus californicus Rohwer
Doryctes sp.
Rhopalicus sp.
Cecidostiba sp.

In the Hopkins (1903) description of *Phloesinus cupressi,* he mentioned having taken it from redwood. Blackman (1942) also reported a single lot taken from redwood in Alameda County. This beetle normally attacks only *Cupressus macrocarpa.*

**Cryphalus* probably *pubescens* Hopkins is the smallest beetle known to attack this tree, being scarcely 1 mm. long. It is very dark brown. It is found in small injured limbs or ones that have been recently broken off. The adults make small radiating galleries. Specimens have been taken in Muir Woods in March and near Rockport in October. In the literature it is recorded as breeding in *Abies.*

Ips latidens (LeConte) is a brownish, cylindrical beetle with three spines on the declivity. It is about 3 mm. long. The writer has examined a single specimen in the collection of the State Department of Agriculture at Sacramento, taken on May 10, 1934, from an ornamental redwood growing at Placerville, California. This species is most commonly found attacking digger and lodgepole pines.

Ambrosia Beetles

**Platypus wilsoni* Swaine is a dark-brown cylindrical beetle with a large head and pointed wing covers. It is about 5 mm. long. Professor Fritz obtained a dead specimen at Samoa, California, from finished lumber in which it had made extensive galleries. Whether it had been breeding in the logs in the field or whether this incidence was merely a case of abnormal attraction to green logs is not known. Normally this species breeds in *Abies, Pseudotsuga, Tsuga,* and *Picea.* In literature it is also recorded from *Libocedrus, Thuja,* and *Pinus.*

Gnathotrichus sulcatus (LeConte) is a slender dark brown cylindrical beetle about 3 mm. long, which commonly breeds in the sapwood of freshly cut stumps and logs. It excavates extensive galleries, which in cross section appear as pin holes, often with stain-

ing around the edges. Adults are found in flight all season long. Attacks generally occur only when the bark is present; consequently, they may be prevented by barking the tree as soon as it is felled. This species also attacks the giant sequoia *Pseudotsuga, Abies, Chamaecyparis, Tsuga, Picea,* and *Pinus.*

**Monarthrum scutellare* (LeConte) is a shiny dark-brown cylindrical beetle with its hind end "cut off" at an angle and with prominent teeth at the sides of the cut. It is about 4 mm. long. This beetle commonly attacks oak, but there is one record of its boring into a recently cut log near Garberville. Professor Fritz, who collected the specimens, states: "Piles of white frass were very numerous on tops of logs. First observed, April 26, 1934. Adults busy flying in numbers above the piles and ever so often one would enter a hole in the log." All other records show this species as breeding in hardwoods, chiefly *Quercus.*

Trypodendron cavifrons (Mannerheim) is reported by Kleine (1934) as having been taken from redwood, but this record is not verifiable. It is known to attack *Pinus, Picea, Alnus,* and *Betula.*

Powder-Post Beetles

**Habrobregmus gibbicollis* (LeConte) is a grayish-brown beetle about 4 mm. long, which commonly bores in the damp sapwood of trees that have been dead several years. The galleries of the grubs make a network of fine holes and the wood is reduced to a powdery condition. Larvae have been collected in October. All stages can probably be found at any time of year. This species is also known to feed extensively in *Pseudotsuga.*

**Ptilinus basalis* LeConte is a cylindrical brown beetle with a darker brown head and pronotum. It is about 4 mm. long. E. G. Linsley has identified adults collected by Professor Fritz near Garberville, California, from redwood siding. This beetle commonly attacks the wood of California laurel (*Umbellularia californica* [Hook & Arn.] Nuttall).

Cerambycid Beetles

**Ergates spiculatus* (LeConte) is the largest beetle attacking redwood and is often nearly 65 mm. long, but some specimens are only 40 mm. long. It is dark brown. The lateral margins of the pronotum bear many small spines, although some specimens almost lack these spines. Linsley collected a larva that was boring in the sapwood of redwood and also in *Abies.* Our records show that it commonly bores in *Pinus* and *Pseudotsuga.*

Prionus californicus Motschulsky is often slightly over 60 mm. long and is next to the largest beetle attacking redwood. It is dark brown, with three large spines on the lateral margins of the pronotum. E. C. Van Dyke told the writer that it breeds in redwood stumps, and that he obtained adults and larvae from the bases of redwood telephone poles. Damage, to have been caused by the larvae of this beetle, has been observed in seasoned burls from Los Gatos. Linsley also recorded it from redwood, *Abies,* and *Pinus.* Additional hosts given in literature for this species are *Pseudotsuga* and hardwoods, such as *Quercus* and *Alnus.*

Semanotus ligneus sequoiae Van Dyke is a beetle about 9 to 12 mm. long, with the base of the wing covers of most specimens reddish and the rest of the body nearly black. The tips of the wing covers of some specimens are blackish with a large black spot at about the middle of each wing cover. This beetle works between the wood and the bark of recently felled or fire-scorched trees. It takes about a year for a complete generation. New adults have been taken early in the spring from wood cut about a year earlier. Pupation takes place in the outer sapwood. This subspecies is known only from redwood.

Callidium sempervirens Linsley is a shiny purplish-green beetle about 9 to 12 mm. long. It has been reared in the Big Basin area from limbs cut about a year and a half earlier. Linsley, who described this species (1942) also obtained his specimens from the Big Basin area, where he found them infesting limbs. This beetle is only known to attack redwood.

Callidium pallidum Van Dyke is similar in shape and somewhat larger than the above-mentioned species. The males are brown and the females green. Specimens in the California Academy of Science have been reared from redwood stumps in San Mateo and Santa Cruz Counties. They were taken in December, January, and March. The species is only known to attack redwood.

Anoplodera impura (LeConte) is about 8 mm. long and has brown wing covers and a darker brown head and thorax. Van Dyke says he believes he has taken it from redwood stumps. Although it is called the redwood borer, there seems to be no authenticated record of its feeding in this host. In literature it is recorded as feeding normally in *Libocedrus.*

Anoplodera mathewsii (LeConte) has a reddish-brown head and pronotum, and yellowish-brown wing covers, each with a large

black spot at the tip. It is about 15 mm. long. Larvae, pupae, and new adults have been collected in the sapwood in May and June from fairly well-rotted old stumps. It is also reported in literature as feeding in *Thuja*.

Anoplodera crassipes (LeConte) is about 10 mm. long. The body is blackish, but the pronotum is covered with short golden hairs and the wing covers are brownish with three (male) or four (female) black bars extending across them. It is recorded by Doane *et al.* (1936) as feeding in redwood, *Pinus*, *Umbellularia*, and *Eucalyptus*.

Leptura obliterata Haldeman is a yellowish-brown beetle about 16 mm. long. The typical subspecies has been taken from redwood stumps and logs. Nothing is known about its life cycle in redwood; other known hosts for the species are *Pseudotsuga* and *Abies*, and in literature *Tsuga*, *Picea*, and *Pinus*.

Atimia dorsalis LeConte is a yellowish-brown beetle with the sides of the body lighter in color. It is about 10 mm. long. Van Dyke reported in conversation having reared it from redwood limbs. Linsley also has a record of it from this host and from *Thuja* and *Juniperus*. However, according to Linsley, the redwood records may possibly involve *A. maritima* Linsley. *A. dorsalis* likewise feeds in *Cupressus* and *Libocedrus*.

Phymatodes decussatus (LeConte) is recorded by Hopkins (1903) as having been reared from a small dead tree. Probably the species was wrongly identified, as it normally feeds in oak. The record probably refers to the following species which is superficially similar.

Phymatodes nitidus LeConte is a shiny blackish-brown beetle about 7 mm. long. It has been reared from the limbs of this host and there is one record, from the California State Department of Agriculture, of larvae believed to have been this species feeding in the cones. Our records show that it also feeds in the giant sequoia, and in *Cryptomeria*, *Cupressus*, *Libocedrus*, *Thuja*, and possibly *Abies*. In the literature it is also recorded from *Juniperus*.

Dicentrus bluethneri LeConte is the smallest cerambycid attacking the redwood. It is about 6 mm. long and is black with a wide interrupted reddish-brown band across the wing covers, which are also tipped with reddish brown. New adults have been taken near Willits in October in pupal cells in dry broken limbs, which had

apparently been broken off the preceding winter. It is also common in *Pseudotsuga,* and Linsley has a record of it from *Abies.*

Other Borers

Anthaxia aeneogaster Castlenau & Gory is a flattened bluish-black beetle about 6 mm. long. Van Dyke reported it as breeding in the sapwood of this tree. A larva belonging to this genus was taken from a limb infested with the cerambycid *Dicentrus bluethneri.* It also attacks the giant sequoia, *Cupressus, Libocedrus, Pinus, Pseudotsuga,* and various hardwoods.

**Serropalpus barbatus* (Schall) has been collected only in the larval stage, boring in the sapwood of a recently killed tree at Navarro. The larva is whitish, cylindrical, and about 20 mm. long. The adult is entirely brown and about 15 mm. long. Our records show that it also feeds in *Libocedrus* and *Abies.*

**Ctenicera* sp. near *rotundicollis* (Say) occurs commonly in the larval stage in the bark of trees about 10 inches d.b.h. near Willits. The larva confines its work to the inner bark, sometimes almost scoring the phloem. The specimens collected were about 8 mm. long with dark brown bodies and lighter brown heads. The urogomphi are bidentate with the inner tooth considerably smaller than the outer. Similar larvae were also collected near Klamath, California, under the bark of this tree.

Dromaeolus nitens Horn. Adults of this species have not been reared from this host, but the larval skins of what is believed to be this species are commonly taken from large galleries in the bark of living trees. In a green tree near Willits as many as 31 emergence holes have been observed in an area of about 10 square feet. Other similar larvae have been taken from cells in the bark. Larvae, which were apparently the same species, have been taken from the bark of the giant sequoia and from the sapwood of *Libocedrus.*

Ceruchus striatus LeConte is slightly flattened jet-black beetle with large jaws and strongly striate wing covers. The jaws of the male each bear a large upright tooth at about the middle of the inner upper margin; those of the female bear two smaller horizontal teeth on the inner upper margin. The beetles are about 13 mm. long. Doane *et al.* (1936) record it as living in the sapwood of dead trees. Linsley also has records of it in dead redwood limbs. In the literature it is recorded from fir, probably *Pseudotsuga.*

Scale Insects

The following scale insects and mealybugs are known to attack

redwood, whether growing under natural conditions or as ornamentals. As practically nothing is known about their biology or distribution in redwood, they are merely listed here.

Insect	*Authority for redwood as host*	*Other hosts given in literature*[1]
Armored scales definitely from redwood:		
Cryptaspidiotus shastae (Coleman)	Essig (1926)	*Cupressus, Juniperus.*
Aspidiotus hederae (Vallot)[2]	Coleman (1903)	*Umbellularia, Pinus, Taxus, and many more.*
Lindingaspis rossi (Maskell)[2]	*ibid.*	*Araucaria* and many others.
Armored scales possibly from redwood:		
Aonidiella aurantii (Maskell)	Calif. State Dept. of Agric. 1942	*Citrus* and many other deciduous hosts.
Hemiberlesia lantanae (Signoret)	*ibid.*	*Abies* (Coleman 1903).
Carulaspis visci (Schrank)[2]	*ibid.*	*Libocedrus, Pinus, Juniperus, Viscum Cupressus, Thuja.*
Phenacaspis pinifoliae (Fitch)	*ibid.*	*Pinus, Pseudotsuga, Tumion, Abies, Picea*
Diaspis carueli (Targioni)[2]	*ibid.*	*Thuja, Libocedrus, Cupressus, Juniperus.*
Lepidosaphes newsteadi (Sulc)[2]	*ibid.*	*Pinus.*
Saissetia nigra (Nietner)[2]	*ibid.*	Many tropical and sub-tropical plants, *Pinus.*
Mealybugs:		
Pseudococcus sequoiae (Coleman)	Coleman (1903)	*Cupressus.*
Pseudococcus ryani (Coquillett)	Essig (1926)	*Cupressus, Libocedrus, Thuja, Pinus, Araucaria.*
Puto cupressi (Coleman)	*ibid.*	*Pinus, Cupressus, Tumion.*
Pseudococcus citri (Risso)	*ibid.*	Wide variety of non-coniferous species.

[1]Most of the hosts have been obtained from Essig (1926) and Ferris (1937).
[2]Probably introduced.

Termites

Zootermopsis angusticollis (Hagan). Linsley has records of what appeared to be this species attacking redwood in contact with the ground near Los Gatos and Santa Cruz. Specimens that are either this species or *Z. nevadensis* (Hagen) have been taken from the sapwood of a scorched living tree near Navarro. These two species are so nearly similar that it is necessary to have soldiers to make a positive identification.

Reticulitermes hesperus Banks has been observed in the San Francisco Bay area, attacking redwood boards that have been in place in the soil less than five months.

Reticulitermes tibialis Banks. Linsley states that he has examined specimens from the bark of a living ornamental tree to which its activities were apparently entirely confined.

Kalotermes minor Hagen has been taken by Professor Fritz in the dead tops of green trees that had just been felled. Adults have also been taken in October at Navarro, where they had just begun to bore into the injured sapwood of a green tree. In addition, Linsley has records of this termite working in redwood rafters in a house at Santa Cruz, in redwood in a residence at San Simeon, and in the sapwood of dead branches at Big Sur.

Aphids

Amphorophoro morrisoni (Swain) is a green aphid which E. O. Essig states, in correspondence, has been taken several times from redwood. He says it "appears on it late in the fall where the sexual forms are developed and eggs are laid on the suckers. This insect also feeds on Monterey cypress and related plants."

Leaf-Feeding Beetles

Dichelonyx valida (Le Conte) is recorded by Essig (1926) as feeding on the leaves of this host. It is a greenish-black scarab about 16 mm. long. The adults are said to appear in April and May.

Moths

**Laspyresia* sp. A heavy infestation of small ivory-colored caterpillars was observed in July and August in the bark of a large living ornamental tree in the East Bay area, but no adults have been obtained. A pupa was observed on August 20. The caterpillars force out borings from their galleries in the shape of little pellets, which are webbed together. They feed both in the dry

bark and in the outer phloem, where the injury causes beads of amber-colored pitch to form.

HORNTAILS

Sirex areolatus (Cresson). The females are metallic blue-black and about 32 mm. long. The males are smaller with the middle five segments of the abdomen brownish-red. The larvae are white, legless, and bear a short, sharp spine at the middle of the last body segment. The female is occasionally observed laying eggs in freshly cut and in fire-scorched trees. The work of the larva is confined to the sapwood, where it makes extensive galleries circular in cross section. Adults have been collected during August in Mendocino County. In literature it is listed as feeding also in *Cupressus, Pseudotsuga, Thuja,* and *Pinus.*

CARPENTER BEES

Xylocopa orpifex Smith is a metallic black bee about 18 mm. long. The hairs on the head and thorax of the male are buff; those of the female, black. The bees bore large holes in sound lumber, where they store the pollen on which the bee larvae feed. They are found in flight most commonly in October, November, and December. The species also breeds in the giant sequoia and in *Juniperus.*

GIANT SEQUOIA INSECTS

BARK BEETLES

Phloeosinus rubicundulus Swain, a reddish, barrel-shaped beetle about 3 mm. long, is the most common insect attacking giant sequoia. It is known to breed only in this host, very commonly attacking freshly broken limbs and tops. Attacks occur chiefly in March, April, and May, with a few throughout the summer. Often limbs lying on the snow are heavily attacked. Attacks average about one per 4 square inches. The galleries are constructed between the wood and the bark along the grain of the wood. They average about 1¾ inches in length. Of 20 galleries measured, the shortest was ¾ inch and the longest 3 3/20 inches. Each female lays about 35 eggs per gallery. The largest number counted was 75; the smallest number 16. Development is rather rapid. Pupae and new adults are found as early as July in limbs attacked early in the spring, and these two stages can still be found as late as October. It is not known whether the beetles that transform to new adults in the middle of the summer emerge immediately or winter over in the limbs and emerge with the main emergence of

the following spring. The beetles are of no economic importance. There is no record of their attacking even weakened or injured standing trees.

Lasconotus vegrandis Horn, also found in the galleries of *Phloeosinus rubicundulus,* is discussed more fully under coast redwood insects.

Nemozoma fissiceps (Fall) is a common beetle in the galleries of *Phloeosinus rubicundulus,* on which it probably preys. It is a very slender, shiny beetle about 5 mm. long. Two hornlike processes are present on the front of the head. The head and posterior half of the wing covers are nearly black; the pronotum and base of the wing covers are yellowish brown. It also occurs in the galleries of other species of *Phloeosinus* in the Sierra region.

Ambrosia Beetles

Gnathotrichus sulcatus (LeConte) is a dark brown, cylindrical, elongated beetle about 3 mm. long, which breeds abundantly in the sapwood. It attacks the trunk of recently felled and wind-fallen trees throughout the summer. Beetles have been taken from fresh attacks as late as October in a tree blown over by a windstorm early in September in Sequoia National Park. A dead adult has been taken from a wound it had made in a healthy standing tree, but there are no records of this species ever becoming established in a living tree. The adult constructs extensive galleries in the sapwood and excavates small "cradles" at the side of its galleries. An egg is laid in each "cradle" and upon hatching the larvae feed on the fungus growth that develops along the walls of the cradles. The fungus is introduced into the tree by the adult beetle. It also attacks redwood and several other genera of conifers listed under that tree.

Flatheaded and Other Borers

Trachykele opulenta Fall is a beautiful golden-green beetle about 12 mm. long, which attacks both young suppressed trees and the wounds of large fire-scorched trees. In its early stages the larvae work in the bark, and between the wood and the bark, but they later mine the sapwood and heartwood. According to one field record they can develop entirely in the thick bark. When fire-scorched trees are attacked the mines are chiefly in the dead sapwood and in the outer wood along the edges of the "cat-face" where the bark is healing over. Mines also occur and emergence takes place in the dead wood of the "cat-face." Records indicate that it

takes at least three years for the beetle to complete its life cycle. Pupation occurs in August, September, and October, and transformation to the new adult stage takes place within a few weeks. The new adults overwinter in their pupal cells and emerge the following spring. *Libocedrus* is also attacked, and in the literature *Thuja* is given as another host.

Anthaxia aeneogaster Castlenau & Gory is a flattened, dark blue beetle about 6 mm. long which has been reared from small, recently broken limbs infested with *Callidium sequoiarum*. Emergence in the laboratory occurred during the spring, summer, and late winter from limbs broken the previous winter. The mines are constructed between the wood and the bark and in the sapwood, where pupation occurs.

Dromaeolus sp. Larvae which apparently belong to this genus have been collected from the thick bark of large standing green trees in Sequoia National Park. This species is further discussed under the heading Coast Redwood Insects.

Roundheaded Borers

Callidium sequoiarum Fisher is a blackish-blue beetle about 8 mm. long which bores between the wood and the bark and in the sapwood of freshly broken limbs. It has been reared during the spring from branches less than 1 inch in diameter, collected the previous winter. It probably has a 1-year life cycle. It constructs extensive galleries, reducing the sapwood to a powder that falls out through breaks in the bark, thus leaving a shell of bark around a core of inner sapwood. Giant sequoia is the only host known to be attacked by this insect.

Phymatodes nitidus LeConte is discussed under coast redwood insects. Larvae were taken at Palo Alto from the trunk of a small tree that had been dead about a year, and a single adult was reared in June from cones collected the previous November in Sequoia National Park.

Semanotus ligneus amplus Casey is a black beetle about 8 to 15 mm. in length, with the basal third of the wing covers reddish and with antennae about half as long as the body. The larvae commonly work between the bark and wood of recently felled or fire-scorched juniper, cedar, and cypress, but specimens taken from giant sequoia in the Mariposa Grove and now in the U. S. National Museum have been checked by Linsley.

LEAF FEEDERS

**Halisidota argentata* Packard is a yellowish moth with reddish forewings marked with silvery spots. It has a wing expanse of about 2 inches. The caterpillars of this moth have been observed to attack and develop to maturity on a tree 25 feet tall in Yosemite National Park. The caterpillars overwintered as small larvae on the twigs and began to feed early in spring. Considerable damage was done to the tree by these caterpillars as early as the middle of March. Pupation occurred in the last three weeks of June. The first moths emerged July 3 and moths continued to emerge until July 17. Damage is caused by the caterpillars chewing off the adnate needles. Many of the twigs were chewed nearly through, causing them to break and hang down. This infestation was controlled by handpicking the larvae. *H. argentata* usually feeds on *Pinus, Abies,* and *Pseudotsuga.*

Argyresthia sp. has been identified by H. H. Keifer, of the California State Department of Agriculture, from foliage of giant sequoia, on which it was apparently feeding.

Cutworms. Damage to trees in nurseries by caterpillars believed to belong to this group of insects is mentioned by Fry and White (1931). The caterpillars are reported to sever the stems just below ground level.

Diaspis carueli Targ. has been identified by Keifer from foliage of giant sequoia.

Aonidiella aurantii (Mackell) has been identified by Keifer from foliage of this tree.

Cryptaspidiotus shastae (Coleman). Infestations of this grayish scale insect have been observed on small trees in Sequoia and Yosemite National Parks, especially along dusty roads. In none of the infestations examined was the damage serious enough to affect the growth of the trees appreciably. Nothing is known about the biology of this insect on giant sequoia. In literature it is listed as attacking the coast redwood and *Juniperus.*

Hemiberlesia rapax (Comstock) was reported by Coleman (1903) as breeding abundantly on giant sequoia in the Stanford Arboretum. It has a wide variety of hosts.

**Carulaspis visci* (Schrank) was observed in February on the leaves of giant sequoia growing as an ornamental at Stanford University. It had a wide variety of hosts.

TERMITES

Zootermopsis nevadensis (Hagen) has been taken from the sapwood of suppressed sequoia trees infested and apparently recently killed by *Trachykele*.

CARPENTER BEES AND ANTS

Xylocopa californica Cresson and *X. orpifex* Smith were found to have had a large colony in the dead top of a green tree 12 feet in diameter when it fell in Sequoia National Park several years ago. *X californica* resembles *X. orpifex,* but is larger and its body has a greenish metallic sheen. The habits of the two species are similar. They bore holes in sound dead wood, where they store pollen on which the bee larvae feed.

Camponotus sp. This ant was taken from the heartwood at the base of the tree mentioned in the preceding paragraph. A fire scar extended nearly around the base of this tree, and the ants were working in the fire-scorched wood. Observations indicated that it was the activity of this insect, coupled with rot, which undermined the support of the tree, causing it to fall. Members of this genus are also very common in old giant sequoia stumps.

The specific names of the two insects listed below indicate that they feed on either of the sequoias, but later records do not bear this out.

Vespamima sequoiae (Hy. Edwards) is listed in the original description as if it fed in *Sequoia sempervirens,* but the writer has been able to find no authenticated later record that it attacks this host. Records obtained thus far indicate that it breeds only in *Pinus* and *Pseudotsuga.* The late G. P. Engelhardt, who revised this family, wrote me that he had no record of this moth working in sequoia.

Sphinx sequoiae Boisduval was described in 1868 from "a single individual found resting on the trunk of a tree in the forests where the gigantic conifers called *Sequoia* grow," hence its name, but so far as is known, no one has ever found it attacking or feeding on *Sequoia.*

SUMMARY

Fifty-two insect species are listed from coast redwood and twenty species from giant sequoia. Nine of these species are common to both hosts, but all nine of them have additional hosts. Four species feed, so far as is known, only on *Sequoia,* three of them

being confined to redwood and the other feeding only on giant sequoia. No insect has yet been found that feeds only on both sequoias.

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COLLECTING BRACHYCISTIDINE FEMALES

(Hymenoptera: Tiphiidae)

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This spring (1952) a collecting party of the California Insect Survey, Division of Entomology & Parasitology, University of California, composed of P. D. Hurd, Jr., G. A. Marsh, P. H. Timberlake and myself, made a considerable effort to collect nocturnal mutillids and tiphiids on the California deserts. The results of this effort were gratifying for six brachycistidine females and numerous mutillid females were taken, as well as a great many males of these two groups.

The first female brachycistidine was taken at Hopkins Well, Riverside County, crawling out of the sand on a sand dune sparsely covered with vegetation. Two additional females were collected about one mile north of Plaster City, Imperial County. Both of these insects were found on fine sand in an area covered with the typical desert flora. The other three females were collected in a sand dune region a short distance east of Borego, San Diego County. Two of them were taken on the leeward side of a road,